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**DE-A-2 332 519
GB-A-1 271 841
US-A-3 122 838
US-A-3 250 012
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US-A-4 238 886**

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Courier Press, Leamington Spa, England.

Description

The invention relates to a probe for checking linear dimensions of mechanical pieces comprising a support; an arm movable with respect to the support and including a first element, a second element and a third intermediate element connected in a removable way to the first and second elements; a feeler fixed to the first element of the movable arm for contacting a piece to be checked; and detection means adapted for providing a signal responsive to the position of the movable arm; the intermediate element including a section adapted to break for protecting the probe from accidental impacts against the feeler and the first element of the movable arm.

There already are known, for use in co-ordinate measuring machines, grinding machines, machining centers, numerically controlled lathes and bench gauges, measuring heads equipped with position transducers and contact-detecting or "touch-trigger" type heads, including movable arms provided with safety devices adapted for preventing the occurrence of any irreparable or serious damages to the head, as a result of accidental impacts striking the feeler or the more exposed part of the movable arm.

A first type of safety device is disclosed in the measuring head described in British Patent No. 1271841; in this head the movable stylus rod includes two parts connected by a resilient detachable coupling including a disk and balls biased by leaf springs. A sufficiently violent blow, striking along a direction that is perpendicular to the disk axis, causes the detachment of the portion of the stylus rod that carries the disk and the lower edge of the stylus rod. When this occurs, the portion can be engaged again in the operating position. This solution is subject to the inconvenience that a sufficiently accurate, stable and repeatable positioning of the detachable portion of the movable stylus cannot be guaranteed. Moreover, this resilient coupling safety device is not efficacious in the event the lower edge of the stylus is struck along an axial direction of the stylus.

Another type of safety device, employed in the measuring heads disclosed in US Patents Nos. 3,122,838 and 4,238,886, foresees frictional devices located between two parts of the movable arm.

These devices, too, are subject to various inconveniences: they are not efficacious in preventing damage from occurring as a consequence of blows in all the possible striking directions and they can give rise to not easily perceivable zero-setting drifts that may pass unnoticed to the operator, who, consequently, does not take any action and so relies on inexact measurements detected by the measuring head.

A third type of safety device is used in the measuring head described in US Patent No. 3,250,012. The movable arm or spindle of this head has a reduced neck portion to assure that the spindle will snap as a consequence of at least

impacts striking along transversal directions with respect to the axis of the spindle. The drawbacks of this solution consist in the necessity of replacing, in case of breakage of the neck portion, the whole spindle and in the absence of protection against impacts along the axial direction of the spindle.

U.S. Patent No. 3,520,063 discloses a gauging head, which is in accordance with the prior art portion of Claim 1, and which comprises a fourth type of safety device; this safety device comprises a sacrificial stud with two ends threaded into two shafts of the movable arm and with an intermediate section where possible breakages occur. This safety device provides advantages like a considerably rigid but sufficiently fragile coupling between the two shafts of the movable arm and allows, in the event of a stud breakage, the resetting of the head efficiency just by replacing the stud. On the other hand the safety stud does not protect against axial loads (directed along the longitudinal axis of the movable arm and of the stud).

It is an object of the invention to provide a gauging or "touch trigger" head equipped with a safety device that is not affected by any of the previously described inconveniences.

According to the invention, there is provided a probe comprising the features set out in Claim 1. Further embodiments of the invention are set out in dependant Claims 2 to 9.

Some embodiments are now described in detail with reference to the accompanying drawings, given by way of non-limiting examples and in which same or equivalent parts are marked with the same reference numbers.

Figure 1 is a side view of a gauging head with two feelers for checking linear dimensions, more specifically diameters of mechanical pieces in the course of a grinding operation equipped with two safety devices, according to a preferred embodiment for this type of application;

Figure 2 is a partial longitudinal sectional view with a different scale, of a movable arm of the head of Figure 1, equipped with a safety device according to a first variant;

Figure 3 is a lateral view, from right to left, of the movable arm of Figure 2;

Figure 4 is a partial longitudinal sectional view with the same scale as that of Figures 2 and 3, of a movable arm of the head shown in Figure 1, equipped with a safety device according to another variant;

Figure 5 is a lateral view, from right to left, of the movable arm shown in Figure 4;

Figure 6 is a perspective view of a head with a movable arm, specifically for applications on machining centers and numerically controlled lathes, equipped with a safety device that is, at least partially, similar to that of Figures 2 and 3;

Figure 7 is a longitudinal view, partly in section, of the safety device of Figure 6; and

Figure 8 is a horizontal sectional view of the safety device of Figure 7, along line A—A in Figure 7.

In Figure 1 there is shown a probe consisting of a gauging head 1 per se known exception made for the safety device that will be hereinafter described.

Head 1 includes a support casing 2, box-shaped, that is clamped to a slide for carrying head 1 to a measuring position for checking the outside diameter of a piece 3, while the latter is being ground by the grinding wheel of a grinding machine.

The slide, the grinding machine and the grinding wheel are not illustrated in the drawings for the sake of simplicity.

Head 1 has two arms 4 and 5, which are mounted on to casing 2 for pivotal movements and carry, at their ends, feelers 6 and 7 adapted for contacting the surface of piece 3. Movable arms 4 and 5 are alike and consequently just the upper movable arm 4 is described.

Arm 4 includes a first element 8, basically located thin casing 2 and pivotally coupled thereto; element 8 passes through a side opening of the casing. The side opening — not shown — is sealed by a flexible gasket, also not shown, which permits rotatory measurement displacements of arm 4. Feeler 6 is fixed to an end of a second element 9 of arm 4; elements 8 and 9 — which define two parallel geometrical axes placed at a prefixed distance — are elongated substantially along the longitudinal axis of head 1, i.e. in a substantially perpendicular direction with respect to the displacement direction of feelers 6 and 7.

Arm 4 includes a third element, 10, located between elements 8 and 9 and, like element 9, placed outside casing 2. Element 10 defines a geometrical axis perpendicular to the axes defined by elements 8 and 9 and has an upper end coupled, by means of a screw 11, to the end of element 9 opposite to that which carries feeler 6. The lower end of element 10 is coupled, by means of a screw 12, to the end portion of element 8 outside casing 2. Elements 8, 9 and 10 also include mechanical abutments, not shown, for defining exactly the reciprocal positions of these elements, when they are coupled to one another.

On casing 2 and at the end portions of movable arms 4 and 5, located inside casing 2, there are coupled the elements of one, or two position transducers, schematically shown with a dashed line and marked with reference number 13, that provide a signal representative of the diameter deviation of piece 3 with respect to a reference or nominal value.

Intermediate element 10 is constructed in such a way as to represent a safety device with respect to any accidental blows against feeler 6 or the more exposed part of movable arm 4, i.e. element 9.

In fact, element 10 has upper and lower sections with rectangular or square cross-sections and an intermediate section, integral with the other two, but with a circular cross-section having a first decreasing and then increasing diameter. The smaller diameter section, 14, forms a weakened section where breakage of arm 4

occurs in the event the previously mentioned blows strike so violently as to be able to cause, in the absence of section 14, considerable or irreparable damages to head 1. Element 10 is made of a negligibly flexible, but rather fragile, material so as to provoke the breakage of section 14 in the event there occur any stresses greater than those that could arise under normal working conditions. At the upper and lower sections of element 10 there are fixed, for example welded, the ends of a helical spring 15 that houses the intermediate section of element 10. Consequently, in the event there occurs the breakage of section 14, element 9 does not fall down, but remains attached to element 8, by means of spring 15, that consequently provides an auxiliary safety device.

In fact, spring 15 prevents element 9 from falling into difficultly accessible or dangerous places, near the grinding wheel or any other movable parts of the grinding machine.

From the preceding description, and with reference to Figure 1, it is understood that the safety device efficaciously intervenes whichever be the direction of the forces originated from accidental impacts of feeler 6 or element 9.

In fact, weakened section 14 defines an axis of symmetry, coincident with the geometrical axis of element 10, that is distant from feeler 6 and located in a different position (i.e. perpendicularly) with respect to the axis of element 9.

Whenever the breakage of element 10 occurs, for example, as a consequence of the dropping of a piece 3 in the course of a loading or unloading operation against element 9, the efficiency of head 1 can be reset in a simple, quick and cheap way, by disassembling the two end sections of element 10 and connecting to elements 8 and 9 a new element 10 with its associated spring 15.

The safety device used in movable arm 4a, shown in Figures 2 and 3, includes an intermediate element 16 basically consisting of a bar with a rectangular or square section that is divided into two parts 16a, 16b by a diagonal cut. The two parts 16a and 16b are glued together by means of an adhesive 17 that, since it has negligible resilience but appropriate fragility, defines a section adapted to break.

This section has a geometrical axis which is inclined with respect to the geometrical axes of elements 8, 9 and 16.

Moreover, intermediate element 16 has a transversal through hole 18 wherein there is housed a return spring 19, the ends of which are coupled to two plates 20 and 21 located at the ends of hole 18. Spring 19 accomplishes functions that are similar to those of spring 15 shown in Figure 1.

Movable arm 4b, shown in Figures 4 and 5, has an intermediate element 22 basically made of a rectangular or square sectioned bar divided in two parts, 22a and 22b, by a cut perpendicular to the axis of the bar. The two parts 22a and 22b are glued together by an adhesive 23 that defines, in this case t o, a prefixed breakage section. The two parts 22a and 22b also have two blind axial communicating holes 24 and 25, wherein there is

h used a steel wire 26 with ends fixed to parts 22a and 22b by means of adhesive 27. The length of the free section of wire 26 is greater than the length of the corresponding portion of element 22. It is obvious that wire 26 serves as a further safety means, in that it prevents element 9 from falling whenever the breakage of the section defined by adhesive 23 occurs.

The safety device provided by element 22 is also efficacious whichever be the direction of the forces originated by accidental blows striking against feeler 6 or element 9. In fact these forces always give rise to a moment with respect to the center of the section of the cut of element 22.

Head 30, shown in Figure 6, includes a cylindrical support casing 31 supporting a movable arm 32 carrying, at an end arranged outside casing 31, a feeler 33.

Head 30, with the exception of the safety device, that is hereinafter described, is of a per se known type and can be a gauging head or a contact detecting head (touch trigger probe). Arm 32 can be movable along one, two or three directions, or according to any direction. The displacements of movable arm 32 from a rest position can be measured or, respectively, the moving away of movable arm 32 from the rest position can be detected by means 34 associated with movable arm 32 and casing 31. These means 34, schematically shown with dashed lines, can consist of position transducers, electrical switches, or equivalent devices and provide, depending on the circumstances, one or more signals depending on the position of movable arm 32. Obviously, if head 30 is a touch trigger probe, the signal or signals are of the ON-OFF type.

In the rest position the geometrical axis of movable arm 32 coincides with that of casing 31.

Detection means 34 are connected by means of a cable 35 — directly or through wireless couplings (inductive, optical, radiofrequency coupling, etc) — to a power supply, detection display, and control unit, not shown. Arm 32 includes a first element 36 that passes through a hole of a sealing diaphragm 37 fixed to the arm and to a ring 38, in turn coupled to an end of casing 31.

A closure plate 39, with a hole for the passage of cable 35, is coupled to the other end of casing 31.

A second element 40 of arm 32 carries feeler 33; element 40 is connected, by means of an intermediate element — consisting of a substantially cylindrical stud 41 —, with element 36. Elements 36 and 40 and stud 41 have the same geometrical axis, coinciding with that of arm 32.

Stud 41, as shown in Figures 7 and 8, includes two threaded ends 42 and 43 that can be screwed into associated threaded holes of elements 36 and 40 —, two chamfered sections 44 and 45 — that define seats for the insertion of a tool or key for locking stud 41 to elements 36, 40 and an intermediate section 46. Intermediate section 46 is divided in two portions 46a and 46b

5 by a diagonal cut that defines two elliptical sections of the intermediate section 46. The two portions 46a and 46b are coupled to each other by means of a joint 47 obtained by spreading an adhesive or glue between the two elliptical sections.

10 The glue or adhesive is chosen so as to guarantee a negligibly resilient, but fragile connection, so as to allow the detaching of sections 46a and 46b whenever feeler 33 or element 40 is accidentally struck with a force that could damage elements 36, 40 or the elements of head 30 located inside casing 31.

15 In portions 46a and 46b there are defined two transversal, aligned through holes, 48 and 49, that house a return helical spring 50, the ends of which are coupled to two plates 51 and 52 that are urged by spring 50 against the external surface of intermediate section 46.

20 Under normal working conditions of head 30, stud 41 acts as a rigid member, since the material of the stud and the adhesive are chosen so as to have negligible resilience. As a consequence of abnormally violent blows striking against feeler 33 or element 40, that give rise to forces in any direction whatsoever, the adhesive which connects portions 46a and 46b suddenly yields so allowing the disjunction of these portions. Spring 50, which is a return spring and consequently tends to urge the two portions 46a and 46b one against the other, so compressing the adhesive, remains operative after the breakage of the adhesive, thus preventing the fall of element 40 — that remains joined to element 36.

25 After the breakage of stud 41, its two ends can be unscrewed — by means of a key — from elements 36, 40 and the integrity of movable arm 32 can be reset by repairing stud 41, or by fitting a new stud. The new stud can be coupled first to element 40 and then to element 36 by using the same previously employed key.

30 In the event the environmental working conditions of head 30 foresee coolants, or other fluids required for cutting operations, that can detrimentally affect the adhesive joining portions 46a and 46b, on the external surface of joint 47 there can be spread a suitable type of paint or protective enamel. The same precaution can obviously be taken for the safety devices shown in Figures 2, and 4, 5.

35 It is important to realize that connecting joint 47 is asymmetric with respect to the axis of stud 41: it defines a geometrical axis that is inclined with respect to the axes of stud 41, of element 36 and of element 40; this axis passes at a defined distance (different from zero) from feeler 33. Consequently, joint 47 accomplishes its function even in the presence of axial loads, i.e. when there occur impacts generating forces acting along the geometrical axis of stud 41. In fact, these impacts generate cutting forces in joint 47.

40 It is obvious that in the event the heads shown in Figures 1 to 8 are arranged in positions where the falling of the elements of the movable arms carrying the feelers cannot cause significant

Inconveniences, there is no need to use safety devices equipped with additional safety means such as springs 15, 19 or 50, or wire 26.

Another variant consists in foreseeing in every safety device two or more sections or joints subjected to safety breakage.

Claims

1. Probe (1; 30) for checking linear dimensions of mechanical pieces (3) comprising a support (2; 31); an arm (4, 5; 32) movable with respect to the support (2; 31), said arm including a first element (9; 40) having a longitudinal axis, a second element (8; 36), and a third intermediate element (10; 16; 22; 41) connected in a removable way to the first (9; 40) and second (8; 36) elements; a feeler (6; 7; 33) fixed to the first element (9; 40) of the movable arm (4, 5; 32) for contacting a piece (3) to be checked; and detection means (13; 34) adapted for providing a signal responsive to the position of the movable arm (4, 5; 32); the intermediate element (10; 16; 22; 41) including a section (14; 17; 23; 47) having a geometrical axis perpendicularly thereto, said section being adapted to break for protecting the probe (1; 30) from accidental impacts against the feeler (6; 7; 33) and the first element (9; 40) of the movable arm (4, 5; 32), characterized in that said geometrical axis is distant from the feeler (6; 7; 33) and in a substantially different position with respect to the longitudinal axis of the first element (9; 40) of the movable arm (4, 5; 32) for protecting the probe (1; 30) from impacts also along the longitudinal axis of said first element.

2. A probe (1; 30) according to claim 1, characterized in that said intermediate element (16; 22; 41) includes two distinct portions (16a, 16b; 22a, 22b; 46a, 46b) connected by means of a joint (17; 23; 47) provided by an adhesive, the joint (17; 23; 47) defining the section adapted to break.

3. A probe (1; 30) according to claim 1 or claim 2, characterized in that said intermediate element (10; 16; 22; 41) includes an auxiliary safety device (15; 19; 26; 50) adapted for remaining operative after the breakage of said section (14; 17; 23; 47).

4. A probe (1; 30) according to claim 3, characterized in that said auxiliary safety device includes a spring (15; 19; 50) adapted for maintaining the first (9; 40) and the second (8; 36) element of the movable arm (4, 5; 32) connected to each other.

5. A probe (1) according to claim 3, characterized in that said auxiliary device includes a connection wire (26) adapted for keeping the first (9) and the second (8) element of the movable arm (4, 5) connected to each other.

6. A probe (1; 30) according to any one of claims 1 to 5, in which said intermediate element (10; 16; 22; 41) of the movable arm (4, 5; 32) defines a geometrical axis, characterized in that this axis is inclined with respect to the geometrical axis defined by the section (14; 17; 23; 47) adapted to break.

7. A probe (1; 30) according to any one of claims 1 to 6, characterized in that said inter-

mediate element (10; 16; 22; 41) is connected to the first (9; 40) and the second (8; 36) element of the movable arm (4, 5; 32) by means of threaded connections (11, 12; 42, 43).

8. A probe (30) according to claim 7, characterized in that said intermediate element includes a stud (41) having two seats (44; 45) for a tool, for connecting and disconnecting the stud (41) with respect to the first (40) and the second (36) element of the movable arm (32).

9. A probe (1; 30) according to claim 2, or claim 2 and any of claims 3 to 8, characterized in that said joint (17; 23; 47) has an external surface coated with a protective paint.

Patentansprüche

1. Meßvorrichtung (1; 30) zum Messen linearer Abmessungen an mechanischen Werkstücken (3) mit einem Gehäuse (2; 31), einem gegenüber dem Gehäuse (2; 31) beweglichen Arm (4, 5; 32), der ein erstes sich in Längsrichtung erstreckendes Element (9; 40), ein zweites Element (8; 36) und ein drittes Zwischenelement (10; 16; 22; 41) als lösbare Verbindung zwischen dem ersten Element (9; 40) und dem zweiten Element (8; 36) aufweist, mit einem am ersten Element (9; 40) des beweglichen Arms (4, 5; 32) befestigten Taster (6, 7; 33) zur Anlage am Werkstück (3) und mit einem Wandler (13; 34) zum Erzeugen eines der Position des beweglichen Arms (4, 5; 32) entsprechenden Signals, wobei das Zwischenelement (10; 16; 22; 41) einen Abschnitt (14; 17; 23; 47) mit einer sich rechtwinklig erstreckenden geometrischen Achse aufweist und als Sollbruchstelle bei auf den Taster (6, 7; 33) und das erste Element (9; 40) wirkenden Stößen ausgebildet ist, dadurch gekennzeichnet, daß die geometrische Achse einen Abstand vom Taster (6, 7; 33) aufweist und in einer im wesentlichen unterschiedlichen Position gegenüber der Längsachse des ersten Elements (9; 40) des beweglichen Arms (4, 5; 32) angeordnet ist, um die Meßvorrichtung (1; 30) gegen Stöße auch in Längsrichtung des ersten Elementes zu schützen.

2. Meßvorrichtung (1; 30) nach Anspruch 1, dadurch gekennzeichnet, daß das Zwischenelement (16; 22; 41) zwei getrennte Hälften (16a, 16b; 22a, 22b; 46a, 46b) aufweist, die mittels einer Haftverbindung (17; 23; 47) miteinander verbunden sind, wobei die Verbindung (17; 23; 47) die Sollbruchstelle bildet.

3. Meßvorrichtung (1; 30) nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß das Zwischenelement (10; 16; 22; 41) eine nach dem Brechen der Sollbruchstelle (14; 17; 23; 47) wirksam bleibende Sicherheitseinrichtung (15; 19; 26; 50) aufweist.

4. Meßvorrichtung (1; 30) nach Anspruch 3, dadurch gekennzeichnet, daß die Sicherheitseinrichtung aus einer Feder (15; 19; 50) besteht, welche das erste Element (9; 40) und zweite Element (8; 36) des beweglichen Arms (4, 5; 32) in gegenseitiger Verbindung hält.

5. Meßvorrichtung (1) nach Anspruch 3, dadurch gekennzeichnet, daß die Sicherheitsein-

richtung aus einem Verbindungsdräht (26) besteht, der das erste Element (9) und das zweite Element (8) des beweglichen Arms (4, 5) zusammenhält.

6. Meßvorrichtung (1; 30) nach einem der Ansprüche 1 bis 5, wobei das Zwischenelement (10; 16; 41) des beweglichen Arms (4, 5; 32) eine geometrische Achse bildet, dadurch gekennzeichnet, daß diese Achse gegenüber der vom Abschnitt (14; 17; 23; 47) der Sollbruchstelle gebildeten geometrischen Achse schräg geneigt ist.

7. Meßvorrichtung (1; 30) nach einem der Ansprüche 1 bis 6, dadurch gekennzeichnet, daß das Zwischenelement (10; 16; 22; 41) mittels Schraubverbindungen (11, 12; 42, 43) mit dem ersten Element (9; 40) und dem zweiten Element (8; 36) des beweglichen Arms (4, 5; 32) verbunden ist.

8. Meßvorrichtung (30) nach Anspruch 7, dadurch gekennzeichnet, daß das Zwischenelement einen Steg (41) mit zwei Sitzen (44, 45) für ein Werkzeug aufweist, mit denen der Steg (41) mit dem ersten Element (40) und dem zweiten Element (36) des beweglichen Arms (32) lösbar verbunden ist.

9. Meßvorrichtung (1; 30) nach Anspruch 2 oder Anspruch 2 und einem der Ansprüche 3 bis 8, dadurch gekennzeichnet, daß die Verbindung (17; 23; 47) eine mit einer Schutzfarbe überzogene Außenfläche aufweist.

Revendications

1. Capteur (1; 30) pour le contrôle de dimensions linéaires de pièces mécaniques (3), comprenant un support (2; 31), un bras (4, 5; 32) mobile par rapport à ce support (2; 31), ce bras comportant un premier élément (9; 40) possédant un axe longitudinal, un deuxième élément (8; 36) et un troisième élément intermédiaire (10; 16; 22; 41) relié de manière amovible aux premiers (9; 40) et seconds (8; 36) éléments, un palpeur (6, 7; 33) fixé sur le premier élément (9; 40) du bras mobile (4, 5; 32) de façon à pouvoir venir au contact d'une pièce (3) à contrôler, et des moyens de détection (13; 34) destinés à fournir un signal correspondant à la position du bras mobile (4, 5; 32), l'élément intermédiaire (10; 16; 22; 41) comportant un tronçon (14; 17; 23; 47) possédant un axe géométrique perpendiculaire à celui-ci, ce tronçon étant destiné à se rompre pour protéger le capteur (1; 30) de chocs accidentels sur le palpeur (6, 7; 33) et le premier élément (9; 40) du bras mobile (4, 5; 32), caractérisé en ce que l'axe géométrique est situé à une certaine distance du

palpeur (6; 7; 33) et est situé dans une position sensiblement différente par rapport à l'axe longitudinal du premier élément (9; 40) du bras mobile (4, 5; 32) afin de protéger le capteur (1; 30) de chocs se présentant aussi le long de l'axe longitudinal de ce premier élément.

5. 2. Capteur (1; 30) suivant la revendication 1, caractérisé en ce que l'élément intermédiaire (16; 22; 41) comprend deux parties distinctes (16a, 16b; 22a, 22b; 46a, 46b) réunies au moyen d'un joint (17; 23; 47) assuré par une substance adhésive, ce joint (17; 23; 47) constituant le tronçon destiné à se rompre.

10. 3. Capteur (1; 30) suivant l'une quelconque des revendications 1 ou 2, caractérisé en ce que l'élément intermédiaire (10; 16; 22; 41) comprend un dispositif auxiliaire de sécurité (15; 19; 26; 50) destiné à demeurer actif après la rupture dudit tronçon (14; 17; 23; 47).

15. 4. Capteur (1; 30) suivant la revendication 3, caractérisé en ce que le dispositif auxiliaire de sécurité comprend un ressort (15; 19; 50) destiné à maintenir le premier (9; 40) et le deuxième (8; 36) éléments du bras mobile (4, 5; 32) réunis entre eux.

20. 5. Capteur (1) suivant la revendication 3, caractérisé en ce que le dispositif auxiliaire de sécurité comprend un fil métallique de jonction (26) destiné à maintenir le premier (9) et le deuxième (8) éléments du bras mobile (4, 5) réunis entre eux.

25. 6. Capteur (1; 30) suivant l'une quelconque des revendications 1 à 5, dans lequel l'élément intermédiaire (10; 16; 22; 41) du bras mobile (4, 5; 32) définit un axe géométrique, caractérisé en ce que cet axe est incliné par rapport à l'axe géométrique défini par le tronçon (14; 17; 23; 47) destiné à se rompre.

30. 7. Capteur (1; 30) suivant l'une quelconque des revendications 1 à 6, caractérisé en ce que l'élément intermédiaire (10; 16; 22; 41) est réuni aux premiers (9; 40) et seconds (8; 36) éléments du bras mobile (4, 5; 32) au moyen de jonctions vissées (11, 12; 42, 43).

35. 8. Capteur (30) suivant la revendication 7, caractérisé en ce que l'élément intermédiaire comprend un tronçon de tige (41) comportant deux appuis (44; 45) pour un instrument permettant d'assembler et séparer ce tronçon de tige (41) par rapport aux premiers (40) et seconds (36) éléments du bras mobile (32).

40. 9. Capteur (1; 30) suivant la revendication 2 ou suivant la revendication 2 et l'une quelconque des revendications 3 à 8, caractérisé en ce que le joint (17; 23; 47) possède une surface extérieure revêtue d'un vernis protecteur.

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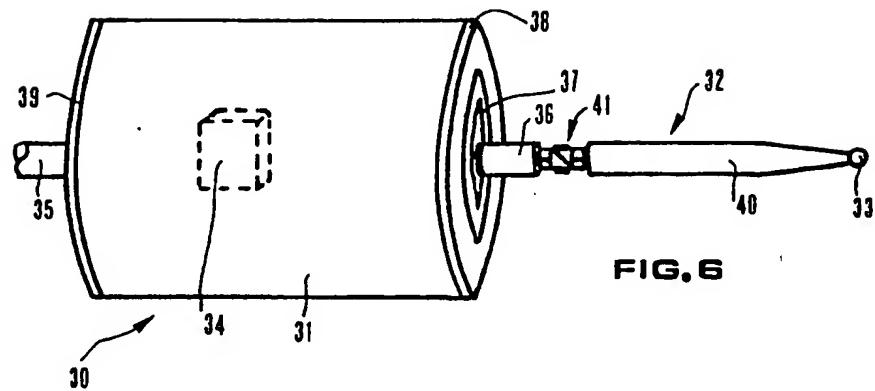


FIG. 6

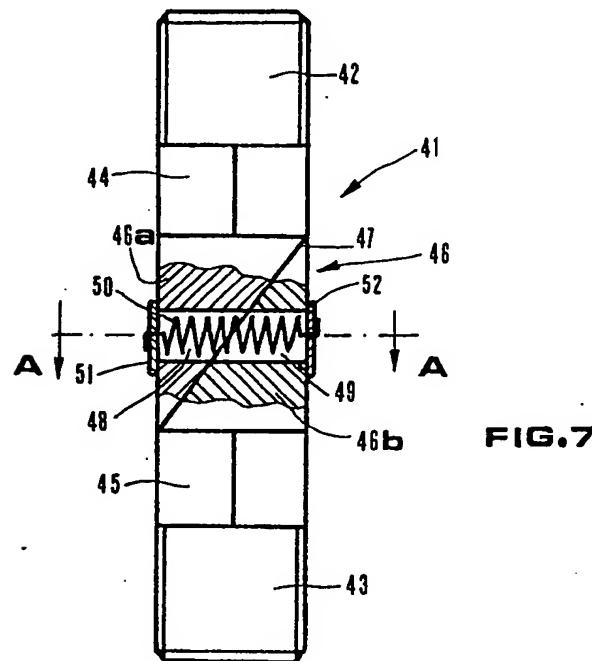


FIG. 7

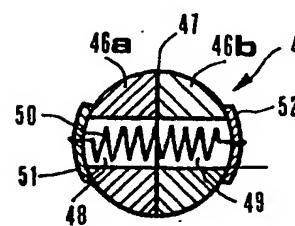


FIG. 8

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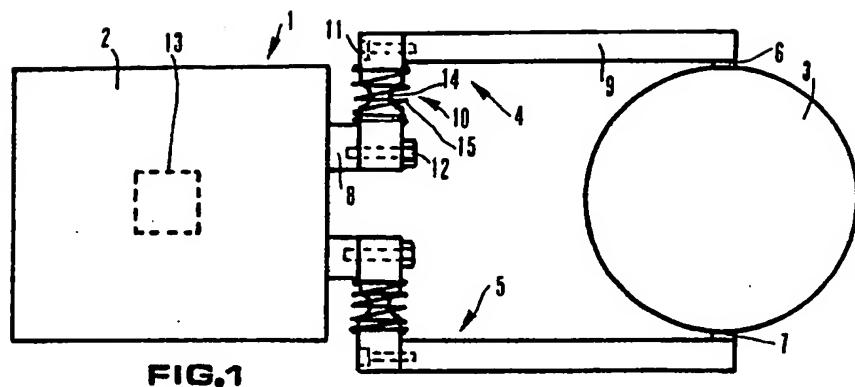


FIG.1

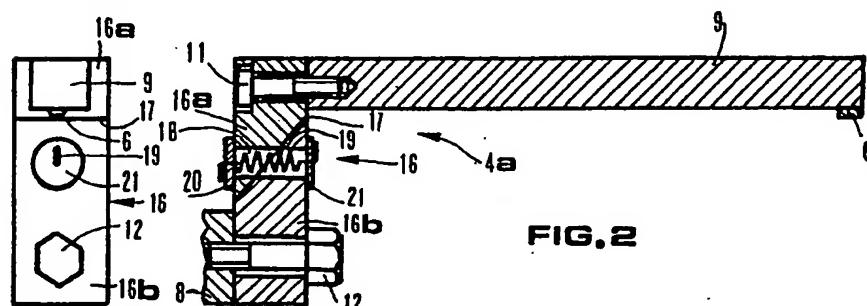


FIG. 2

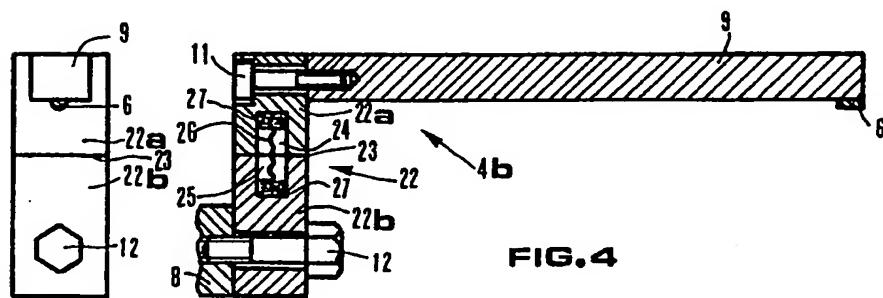


FIG. 4

FIG.5